Space Weather Technical Forecast

Issued on Monday 24 March 2025 at 01:09 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: G1-G2 storms likely Day 1 (24 Mar), then again from late Day 2 (25 Mar) onwards.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the past 24 hours, with occasional C-flares. There are nine sunspots on the Earth facing disc, the vast majority of which are relatively small and magnetically simple and either stable or in slight decay. AR4036, in the northwest quadrant, remains the most significant group, but after an earlier period of rapid growth it is now consolidating and is magnetically simple. AR4037 has reappeared.

No Earth-directed CMEs were observed leaving the Sun during the period.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by DSCOVR at L1, declined from near 480 km/s down to background levels, currently around 370 km/s. Density was average. Interplanetary Magnetic Field, Bt, was weak throughout, at 8nT or lower. The north-south component, Bz, was also weak, ranging between +1 and -5nT. Phi angle was mostly negative (towards the sun). Geomagnetic activity was Quiet to Active (Kp1-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was at background to moderate levels. The 24-hour fluence was below the Active threshold. The observed integrated pfu was 9.23e6 at 24/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Low activity is expected, with a slight chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A faint halo CME was observed at 21/1558 UTC. This was initially forecast to arrive at Earth during 23 Mar, but may be slower than first thought with an arrival early on Day 1 (24 Mar) still possible. There is a second CME, originating around 22/1400 UTC, which is of lower confidence. This CME may also arrive at Earth later on Day 1. Otherwise, solar winds are expected to continue at background levels, likely becoming enhanced with any CME arrival(s) on Day 1, perhaps reaching elevated to strong levels. Solar winds should then gradually decline into Day 2 (25 Mar), before the potential arrival of the HSS from the large CH25/+ from late Day 2 or early Day 3 (26 Mar) onwards.

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Quiet to Unsettled geomagnetic conditions are likely initially, before rising to G1-G2/Minor-Moderate storming following any CME arrival on Day 1 (24 Mar), with a slight chance of G3/Strong storming. There is a further chance of G1/Minor storms from late Day 2 (25 Mar) onwards due to the arrival of the HSS from CH25/+.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a slight chance of enhancement from any larger flares. High energy electron flux is expected to continue at largely background to moderate levels until later in the period, when it may become diurnally high. Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period.

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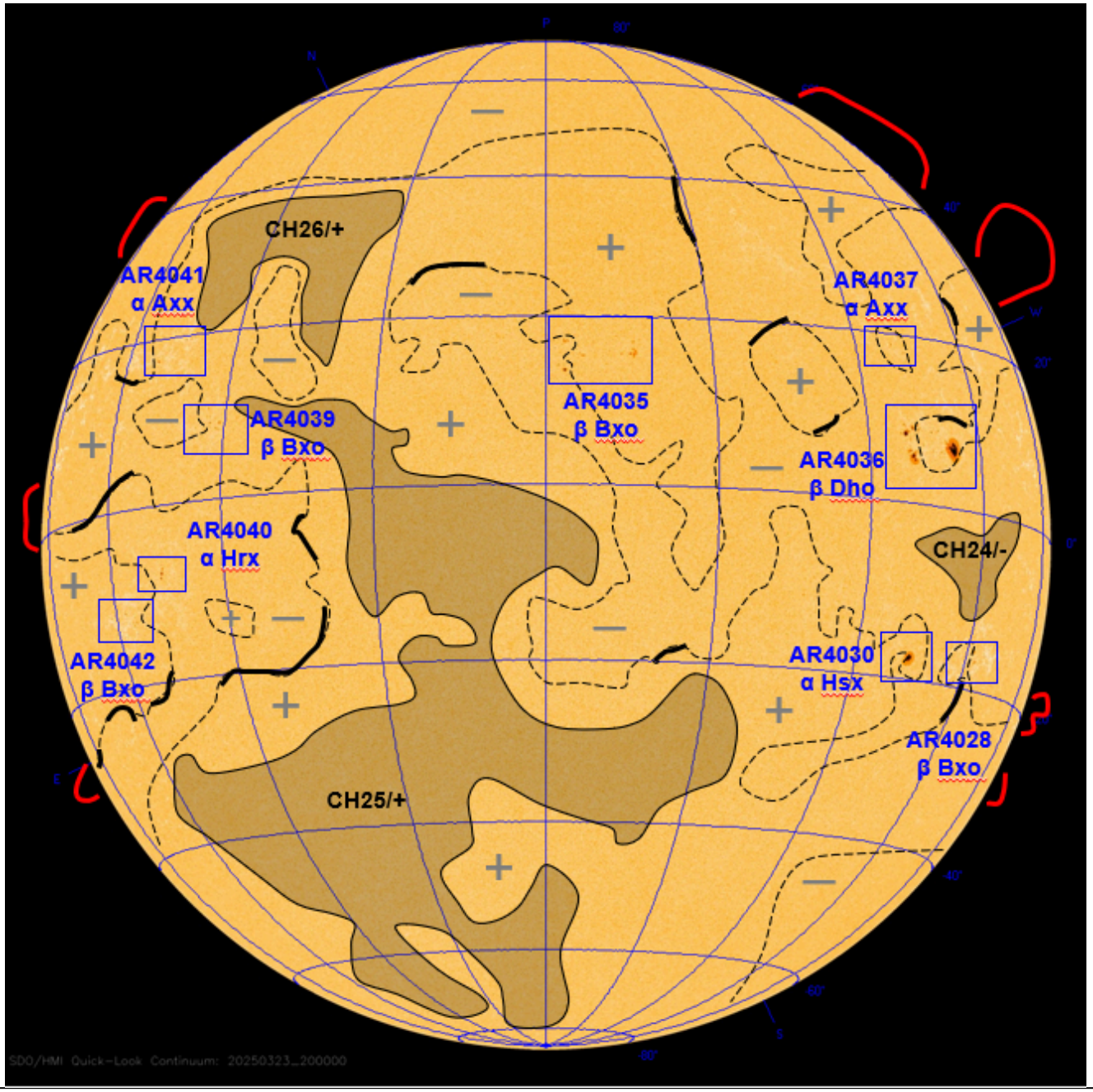
Figure 1: Solar Synoptic Map valid 23/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

Two CMEs feature in the forecast.

A faint halo CME was observed leaving near centre disc following the M1.2 flare from AR4028 at 21/1558 UTC. This was initially analysed as a fast CME with speeds in the region 800-1200km/s as it left the Sun, with an expected arrival at Earth on 23 Mar. This has yet to be observed at L1, possibly due to it being slower than initially thought. An arrival early on Day 1 (24 Mar) is still possible, potentially bringing elevated to strong solar winds speeds at L1. There is a second CME, originating around 22/1400 UTC, which is of lower confidence. This CME may be associated with a small filament eruption near centre disk and was also at a similar time to two northern directed CMEs. Given the lack of STEREO-A imagery and the ability to triangulate this CME, it is not known for definite if this is a near or far-sided feature, with a possible arrival on 24 Mar should it be near-sided.

Otherwise, solar winds are expected to continue at background after waning CH influence, but are likely to become enhanced with any CME arrival(s) on Day 1 (24 Mar), perhaps reaching elevated to strong levels. Solar winds should then gradually decline into Day 2 (25 Mar), before the potential arrival of the HSS from the large CH25/+ from late Day 2 or early Day 3 (25-26 Mar) onwards.

Quiet to Unsettled geomagnetic conditions are likely initially, before rising to G1-G2/Minor-Moderate storming following any CME arrival on Day 1 (24 Mar), with a slight chance of G3/Strong storming. There is a further chance of G1/Minor storms from late Day 2 (25 Mar) onwards due to the arrival of the HSS from CH25/+.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	70	30	50	70
Strong	G3	No	20	1	5	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
21/1830	Full Halo	M1.2/Filament	Centre	1200	23/1400	Faint so unlikely to be material-rich, but fast and possibly enhancing already fast winds and disturbed near earth environment. Arrival still possible 24 Mar.
22/1810	Partial	Filament	Centre (possibly far-side)	1000	24/1200	Low confidence on lift off and lack of STEREO imagery so could be far-sided.

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Figure 2: MOSWOC Enlil model. Note that CME arrival is likely slower than modelled.

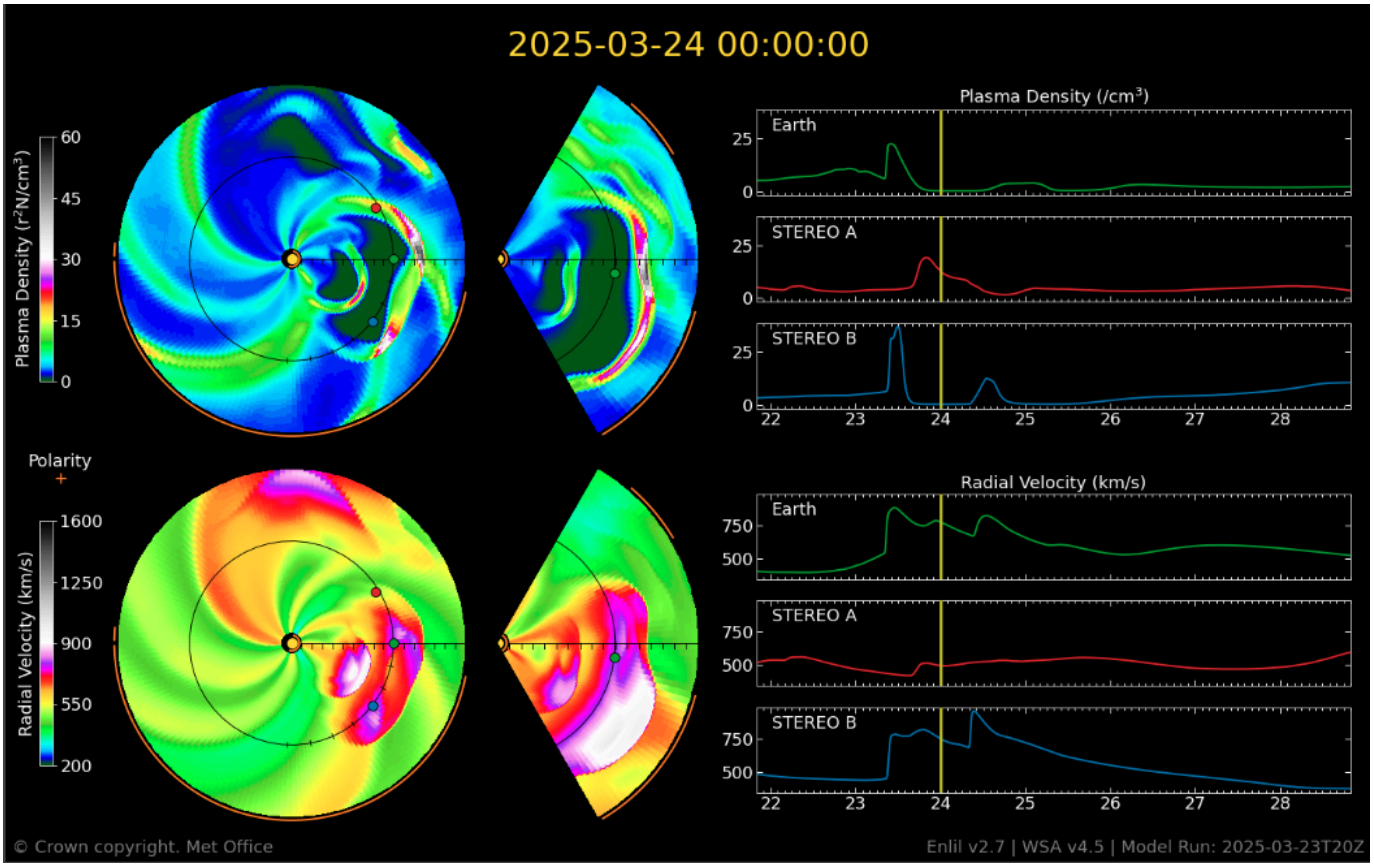

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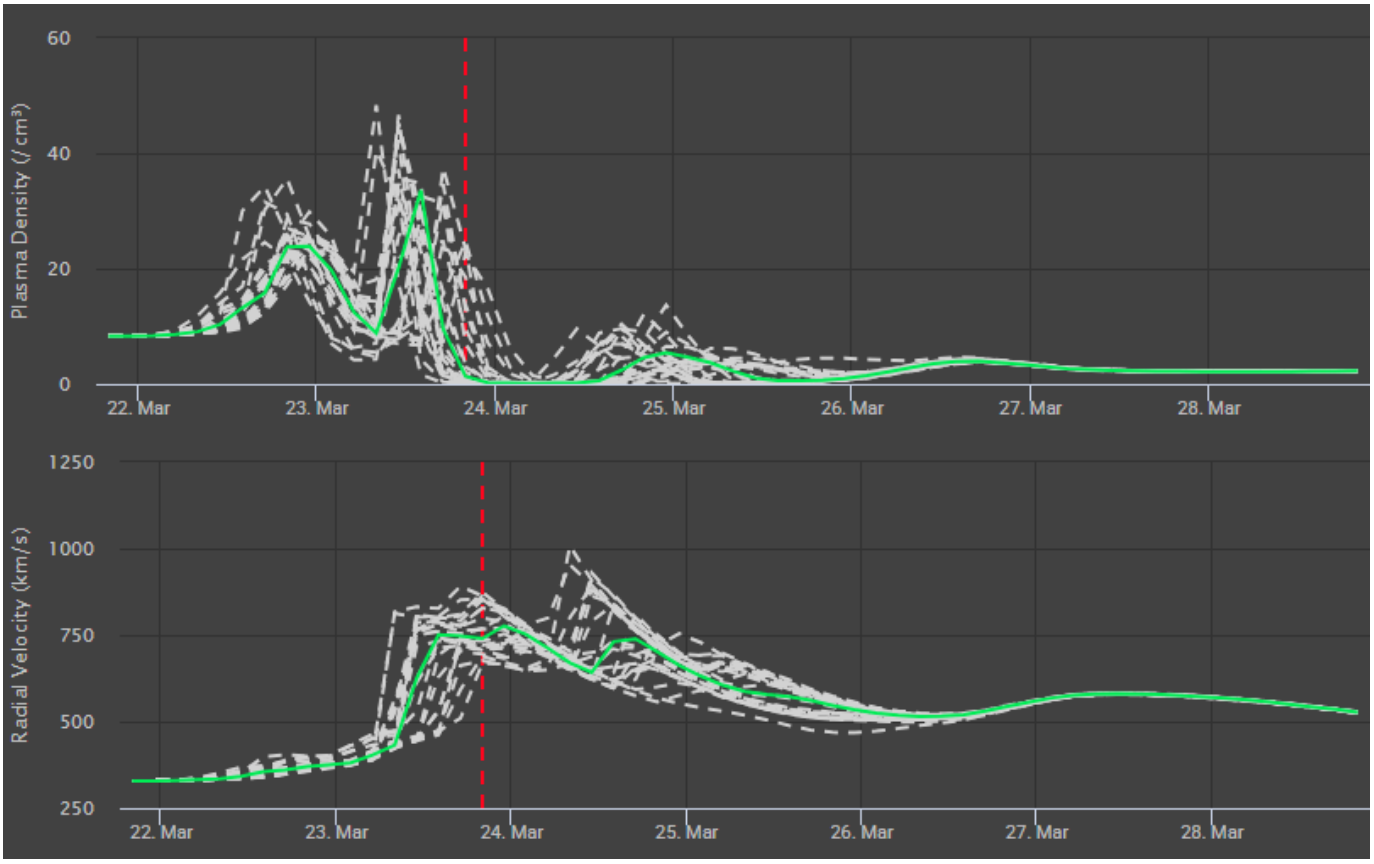
Figure 3: MOSWOC Ensemble model.



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Radio Blackouts - X-Ray Flares

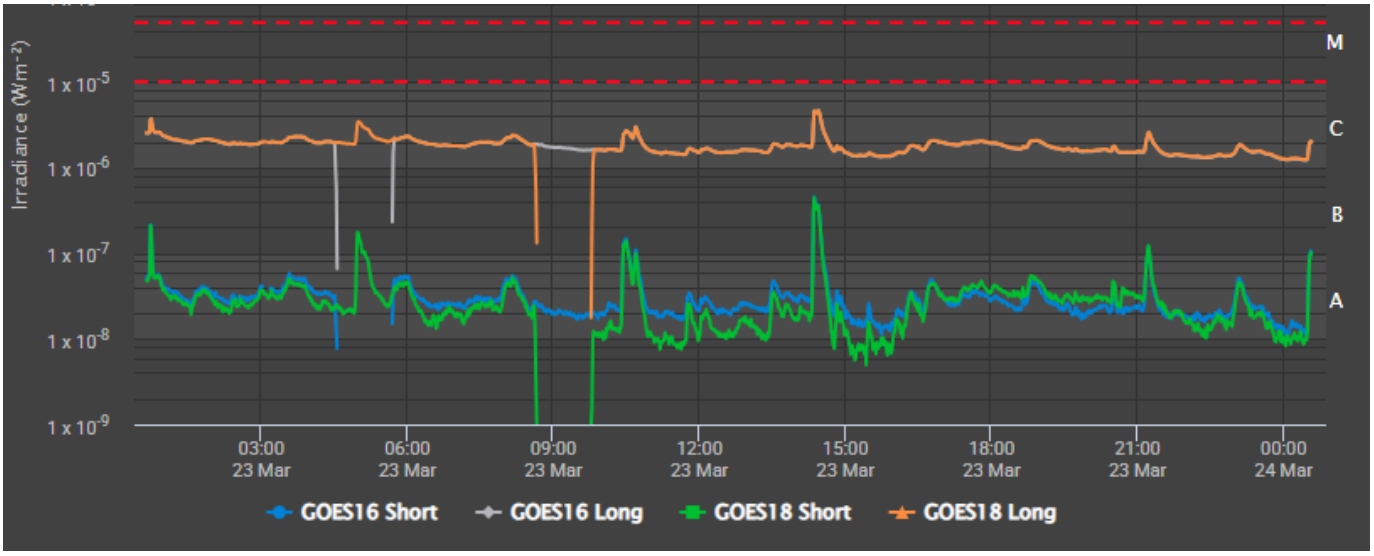
Solar activity has been Low in the past 24 hours, with occasional C-flares.

There are nine sunspots on the Earth facing disc, the vast majority of which are relatively small and magnetically simple and either stable or in slight decay. AR4036, in the northwest quadrant, remains the most significant group, but after an earlier period of rapid growth it is now consolidating and is magnetically simple. AR4037 has reappeared.

Generally Low activity is expected, with a slight chance of isolated M-class flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	20	20	20	20
Very Active	R3-R5 (X Class)	No	1	1	1	1

Figure 4: GOES-16 & -18 X-ray flux.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux was at background levels. Proton flux is expected to remain at background levels, with only a slight chance of enhancement due to the current lack of large, complex spot groups on the Earth facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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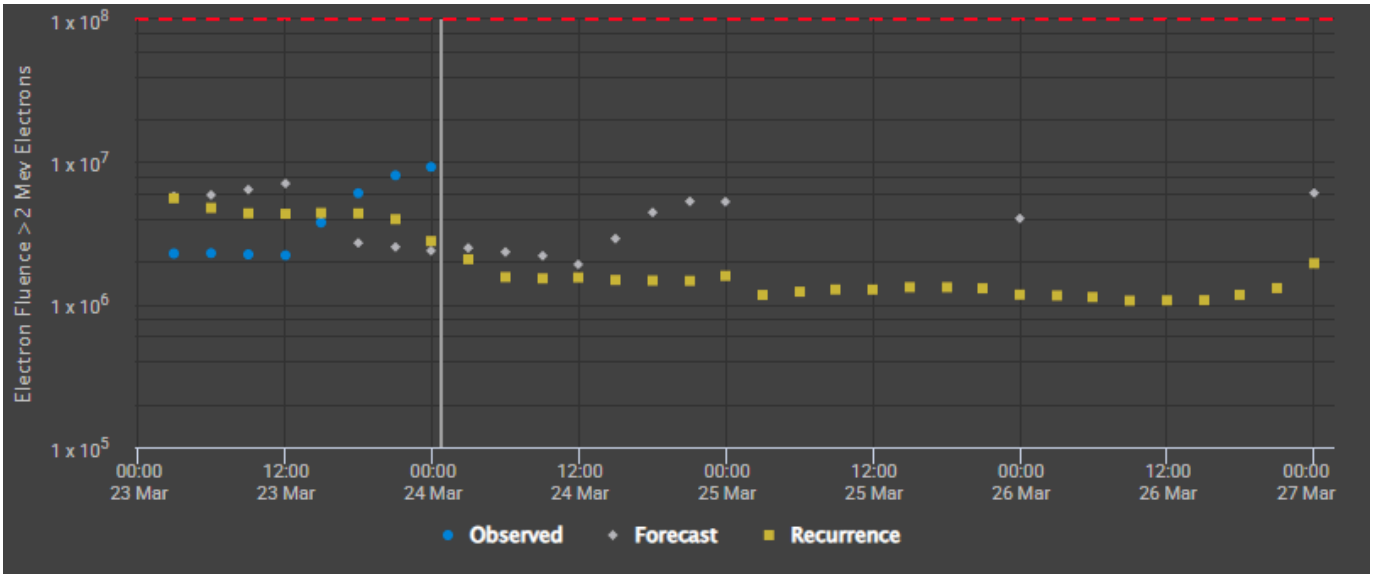
High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux was at background to moderate levels. With CME and CH HSS influences expected through the period, flux levels are expected to remain at similar levels until later in the period, perhaps becoming diurnally high by Day 3 (26 Mar) and beyond.

MOSWOC REFM shows the electron fluence should remain below the Active threshold throughout the period, and is considered reasonable guidance with moderate confidence currently.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: MOSWOC REFM.



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